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FEED ADDITIVES, MINERALS, AND VITAMINS FOR DAIRY CATTLE

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Before discussing this topic, it is quite necessary to be familiar with some of the basic factors concerned with dairy cattle nutrition. In order to do this, the problem can be focused in its proper perspective by drawing contrasts with other types of domestic animals. For instance, the dairy cow, as she is fed at the present time, largely subsists on feeds quite similar to those which she consumed in her natural habitat, that is pasture and forages. On the other hand, some other classes of livestock such as swine and chickens now reared under more artificial conditions no longer subsist on the feeds of their natural habitat. For this reason, supplements containing minerals, vitamins, and other required nutrients are added to the diet of swine and chickens in contrast to that of the dairy cow.

One other basic factor is the fact that the dairy cow has a very unique organ, the rumen, which holds two to three bushels of material. The rumen acts as a fermentation vat mediated through the action of bacterial fermentation. These bacteria break down the feed nutrients into many simple compounds which are re-synthesized into many new nutrients or compounds. For instance, carbohydrates are broken down by bacterial fermentation into organic acids such as propionic, acetic, and butyric, which in turn serve as a source of energy. As a matter of fact, the organic acids produced in the rumen form a large part of the energy source of the dairy cow. Likewise, protein is broken down into amino acids and into other simple nitrogen compounds such as NH_3, which may also be re-synthesized by the bacteria into protein. These bacteria then are digested and form the source of protein for the dairy cow. Similarly, many vitamins are synthesized through the bacterial fermentation which takes place in the rumen. Such vitamins as Vitamin B-12 and ribo-flavin and other B-vitamins are formed in the rumen. For this reason, the dairy cow's requirements for these particular vitamins are, therefore, automatically supplied through this symbiotic relationship. The fact that the bacteria in the rumen synthesize these many vitamins which are then transported to the udder to be secreted into the milk makes milk one of the most nutritious foods we know today.

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It is evident that the cow in contrast to the chicken and pig is relatively independent of certain complicated ration problems since the rumen synthesizes the necessary vitamins and amino acids, and her ration usually consists of several natural feeds that have few inherent or other deficiencies.

Despite the simple needs of the dairy cow, we have made it necessary to supplement her ration to a greater extent than when she existed in her natural habitat because, through breeding and selection, we have tremendously increased her level of milk production above that which she produced in her original habitat. She requires more energy and sometimes protein, minerals, and vitamins. The purpose of this discussion is to point out the needs of the dairy cow in regard to minerals, vitamins, and other proposed additives.

The mineral needs of the dairy cow are quite simple because she consumes large amounts of forage which contain a good supply of most of the mineral elements. For instance, forage furnishes more than enough calcium necessary for maintenance and to secrete milk which contains large amounts of calcium. Where high protein concentrates are contained in the grain mixture, an extra source of phosphorus does not usually need to be supplied. On the other hand, if the grain mixture contains only the cereal grains and other low phosphorus feeds, then some supplemental supply of phosphorus is generally required. This is usually furnished in the form of bone meal, di-calcium phosphate, or deflorinated phosphate added to the concentrate mixture. A mineral requirement often overlooked is common salt, which furnishes the very necessary sodium and chlorine, of which sodium is most important. More recently, it has been found that certain deficient areas exist where the naturally grown feed supply is deficient in particular nutrients. In order to overcome this difficulty, most commercial feed mixtures contain sources of iron, copper, cobalt, and iodine. These trace minerals can also be fed in a trace-mineralized salt mixture. There does not appear to be a need for highly complex costly mineral mixtures containing elements other than those previously mentioned.

The vitamin requirements for the dairy cow are indeed very simple because as we discussed before, many of the vitamins are synthesized in the rumen of the dairy cow. Insofar as we know, the only two vitamins required by dairy cattle from the feed supply are Vitamins A and D.

Vitamin A deficiency does occur, although infrequently, in farm herds where the quality of forage is poor or where an insufficient quantity of forage is fed young animals. Good quality of forage is the primary source of carotene, or pro-vitamin A. Dehydrated alfalfa, pasture, grass silage, and good quality hay are important sources of carotene. Since good quality forage furnishes a sufficient supply of carotene,

it is not generally recommended that a Vitamin A supplement be added to rations fed to mature dairy cattle. On the other hand, Vitamin A is generally added to calf starters. This addition is made because calves do not consume large quantities of forage in their early period of growth and may have only a small store of Vitamin A at birth.

Vitamin D is likewise contained in the forages which dairy cattle consume. Under average conditions, it is not generally recommended that Vitamin D be added to the rations of mature dairy cattle. On the other hand, Vitamin D is generally added to calf starters.

During the past ten-year period, we have heard considerable about the use of antibiotics in the diets and rations of domestic animals. They are widely used in the diets of the chickens and swine, and in beef cattle fattening rations. It would not be unusual, therefore, that some thought has been given to their use in feeds of dairy cattle. Antibiotics are now added to commercial calf milk replacers and starters. The antibiotic, in this instance, is fed for a period of 10-12 weeks and has the effect of increasing rate of gain and decreasing losses due to scours. Quite likely under practical conditions, the latter effect is the one of the greater importance since the effect on rate of growth disappears during the subsequent growth period.

Recently, many advertisements have appeared in farm papers recommending the use of aureomycin in the rations of mature dairy cattle. This inclusion has been based on the premise of preventing foot rot, and other low grade infections. The antibiotic is likewise supposed to increase milk production. Data supporting these particular claims are not adequate at this time. Such data as do exist at this time do not indicate that aureomycin should be used. Therefore, at this time it is not advised to add it to the rations of mature dairy cattle.

During recent years, hormones have entered the picture in the feeding of various classes of livestock. These hormones are normally secreted by the various internal glands in the body and control various physiological activities. It is possible to concede that if we understood the exact amount and definite secretion rates of these various hormones in the body of a cow, then it might be possible to make a good cow out of a poor cow, or even a dairy cow out of a beef cow by merely feeding or injecting these hormones in their proper sequence and amounts. However, at the present time, we do not have information on the correct balance between the many hormones secreted in the animal body so that, while we may have one or more commercially available at the present time, we are not able to make complete or intelligent use of them. It is likewise very probable when only a single hormone is injected or fed, that the animal body in time develops a defense or inactivating mechanism against the particular hormone. Therefore, it seems quite probable that a single hormone may affect, for instance, production

for only a short period of time and that the effect cannot last. Until such time that we have a better understanding of the complete balance and rate of secretion of the various hormones, it does not seem likely that they will be used over extended periods of time to increase milk production.

The hormone, thyroprotein, fits into this particular picture. Extensive experiments conducted at Beltsville have shown that this hormone does very materially increase the level of milk production for a period of three to four months. However, the total milk production for the lactation is not increased where intake of energy is equalized. Except under very specific conditions, where the dairy farmer desires to increase milk production during the base period, thyroprotein feeding is not recommended.

Stilbesterol is another hormone which has been used in the fattening rations of beef cattle. It promotes increased feed efficiency and rate of gain. To date, there is no clear cut evidence with which we could recommend its use in rations fed to lactating dairy cows. Experimental work at Beltsville with lactating dairy cows did not demonstrate an advantage for feeding stilbesterol for increasing milk production, while similar-work at Kansas did show some slight advantage.

One other feed additive which has been recommended for the addition to grain mixtures fed dairy cattle is sodium propionate. This addition is for the purpose of preventing Ketosis, or Acetonemia, a metabolic disease, which occurs usually one to three weeks following calving. In Ketosis, there is a marked loss of appetite and lowered milk production. The veterinarian generally treats the condition by injection of calcium gluconate or cortisone or a combination of the two. Research has shown that the feeding of sodium propionate is effective in the prevention of this disorder. However, there has been a problem of palatability of the feed in which the propionate is mixed.

More recent studies have shown that the addition of both calcium and sodium lactate is also effective in the prevention of Ketosis and is also somewhat more palatable when mixed into the grain ration. These lactate salts are fed for a period of seven to eight days as 6-10% of the concentrate mixture. It seems quite likely that commercial feeds will contain these additives for the prevention of Ketosis in dairy cows where Ketosis is a problem. It should be borne in mind that their use does not always completely prevent the occurrence of Ketosis.

Another metabolic disorder, milk fever, can be prevented to a considerable extent by the addition of fairly large amounts of Vitamin D to the ration. Milk fever is a metabolic disturbance which occurs one to three days after calving and is accompanied by a low blood calcium and a partial paralysis of the animal. It is treated by the veterinarian by the injection of calcium salts or inflation of the udder.

It has been found that this metabolic disturbance can largely be prevented by feeding 5-30 million units per day of Vitamin D for three to seven days before and one day after calving. It is believed that this procedure is effective and that Vitamin D in the form of irradiated yeast will probably be mixed into commercially mixed feeds and used in herds susceptible to milk fever.

Recent experimental results reported simultaneously from the laboratories of the Dairy Cattle Research Branch at Beltsville and the Ohio Agricultural Experiment Station have shown that certain rumen bacteria require two types of short chain fatty acids for normal growth in the test tube. At our Beltsville laboratories, it was found that Bacteroides succinogenes, a cellulose digester, requires any one of the branched-chain saturated acids, isobutyric, isovaleric, or DL-a-methyl-n-butyric acid, as one component. Any one of a number of straight-chain saturated fatty acids C5 to C8 is required as the second component for the growth of these rumen bacteria under test tube conditions.

The evidence that the addition of materials containing these fatty acids to normal rations fed to dairy cattle will cause an increase in digestibility of the cellulose in the ration is somewhat conflicting. However, it seems unlikely that they will improve the overall efficiency of the ration since these acids are present in the normal rumen contents. Whether these acids are produced in sufficient quantity in the rumen to promote normal cellulose digestion, where an unbalanced ration is fed, such as one low in protein, seems unlikely on the basis of present evidence. However, until such time that good proof of the value of such products in the rations of cattle is forthcoming, we should guard against their indiscriminate sale and use. The same is true for rumen bacterial cultures.

About 20 years ago, an attempt was made to introduce the "Spangenberg process" of growing sprouted grains in cabinets as a source of nutrients for livestock. The grains, corn, barley, oats, etc., are sprouted in trays in a cabinet in contact with a hydroponic or nutrient solution. After 8 to 10 days of growth, the tray contains a mass of green material and roots. For instance, one pound of oats will produce four or five pounds of green feed material. A process being offered for sale which is similar to, if not identical with, the "Spangenberg process" has come to the attention of the Dairy Cattle Research Branch during the past few years.

The "Spangenberg process" was investigated quite extensively in England between 1925 and 1935. The results reported, where controlled experiments were conducted, were not advantageous for the process. Some investigators reported a loss of as much as 25% of dry matter as a result of the sprouting process. This loss in dry matter would mean a corresponding loss in energy value of the feed. Some analyses showed a gain in protein percentage but it is not clear from the data whether

there was an actual gain in protein due to synthesis or whether the gain was due to the dry matter loss.

Contrary to the claims for the "Spangenberg process" the feeding of sprouted grains did not result in an increase in the digestive processes of the animals. Also, there was no improvement in the reproductive processes or general health of the animals.

In this present day trend of grassland farming where the principal source of nutrients for dairy cattle should come from forages, there would be little economic advantage to a process which would require the feeding of grains in place of forage nutrients. If a farmer has poor quality forage, there are other methods of supplementing the ration economically, for instance, by the use of dehydrated alfalfa. Since the feeding of sprouted grains did not continue as a feeding practice in England or the United States twenty years ago, it is unlikely that the process has very much value today for the economical feeding of livestock.

SUMMARY

In summary, it can be stated that the needs of the dairy cow for feed additives, minerals, and vitamins are relatively simple. This is due to the fact that the dairy cow today still subsists largely on natural feed sources, that is, forages, which supply many of the vitamins and minerals necessary to health, reproduction, and lactation. Likewise, the dairy cow is unique in that she has a rumen containing large numbers of bacteria which rebuild feed nutrients and synthesize many of the vitamins. The only minerals that are generally necessary to add to the rations of dairy cattle are phosphorus and common salt. In some deficient areas, iodine, copper, cobalt, and iron are needed. The only two vitamins which we know that are required in the feed supply by the dairy cow are Vitamins A and D. These are furnished in ample supply by good quality forages fed the mature animal. Vitamins A and D are usually added to calf starters for growing calves. One antibiotic, aureomycin, is used in calf starters and is quite effective in promoting increased rate of growth and in decreasing the amount of scours. Its addition to the ration of mature dairy cows is not recommended. The use of sodium propionate or a combination of calcium and sodium lactate salts are moderately effective in preventing Ketosis in dairy cattle. The addition of Vitamin D is also effective in the prevention of milk fever. The feeding of thyroprotein, except under certain specific conditions, is not justified. The evidence at present does not warrant the use of stilbesterol. The addition of sprouted grains or various rumen bacterial factors is not justified.